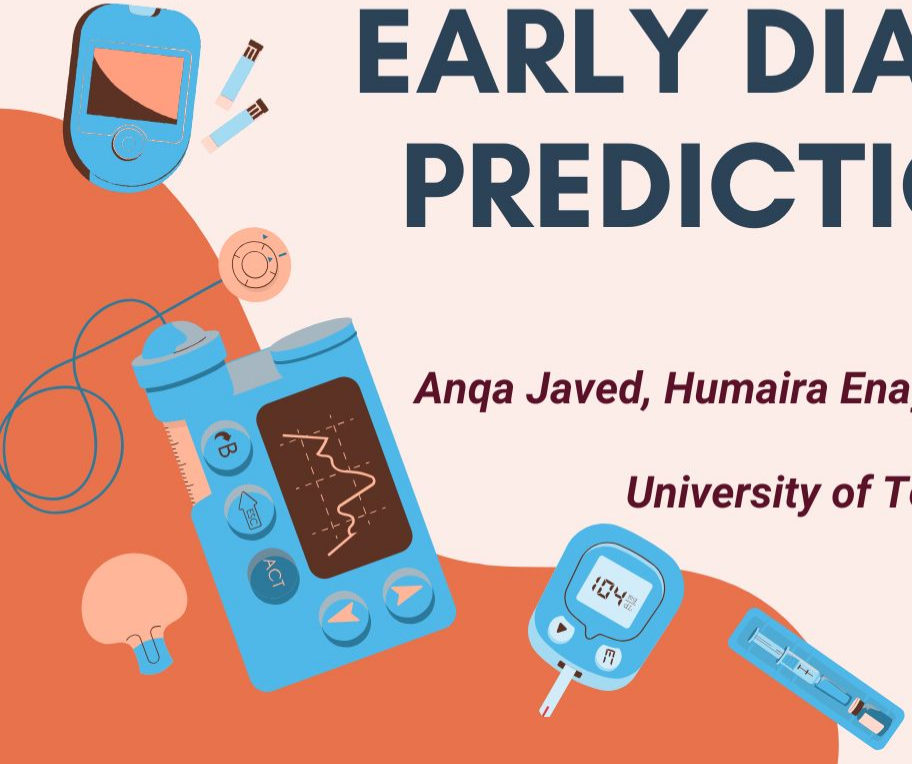
EARLY DIABETES RISK PREDICTION MODEL



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*"Based on latest International Diabetes Federation (2025) report, **1 in 9 adults** (20-79 years) are living with diabetes, with **over 4 in 10 unaware** that they have the condition.*

*Moreover, **over 90%** of people with diabetes have **type 2 diabetes**, which is driven by socio-economic, demographic, environmental, and genetic factors."*

Project Overview

This project develops a machine learning model to predict an individual's risk of diabetes. The model aims to:

- Predicts diabetes risk using CDC BRFSS health data.
- Targets early intervention for high-risk individuals.
- Deployed as an interactive Gradio app.

Objectives

1. Develop a machine learning model to predict an individual's risk of developing diabetes based on clinical and lifestyle data

2. Analyze which health factors are most important in predicting diabetes risks.

3. Predict whether a person has risk of diabetes using basic health indicators like BMI, smoking , alcohol use, physical activity.

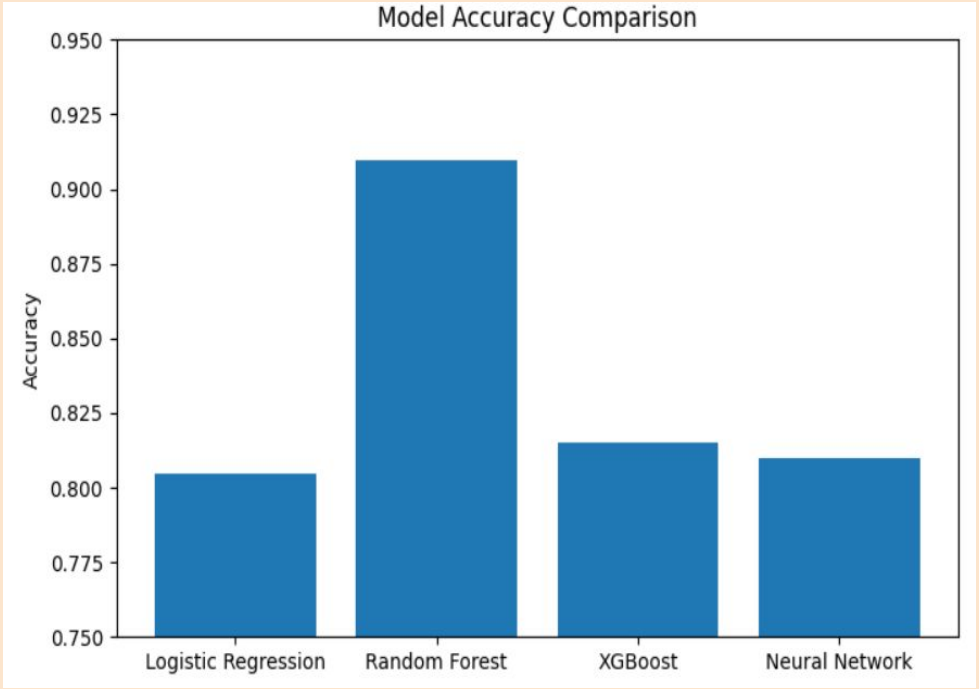
4. Deploy an interactive tool where users can input lifestyle data and receive a personalized diabetes risk score.

Tools & Technologies

- **Dataset Source:** Diabetes Health Indicators Dataset (Kaggle) with 253,680 records
- **Python:** pandas, numpy, scikit-learn, matplotlib, seaborn, XGBoost
- **Visualization:** Plotly, Tableau
- **Deployment:** Gradio
- **Development Environment:** Jupyter Notebook

Machine learning Model

- We used a **Random Forest Classifier** to predict diabetes risk.
- Random Forest builds **many decision trees** and combines their predictions.
- Each tree makes a decision based on health features like:
  BMI, Age, Blood Pressure, Physical Activity
- The final prediction is based on the **majority vote** from all trees.

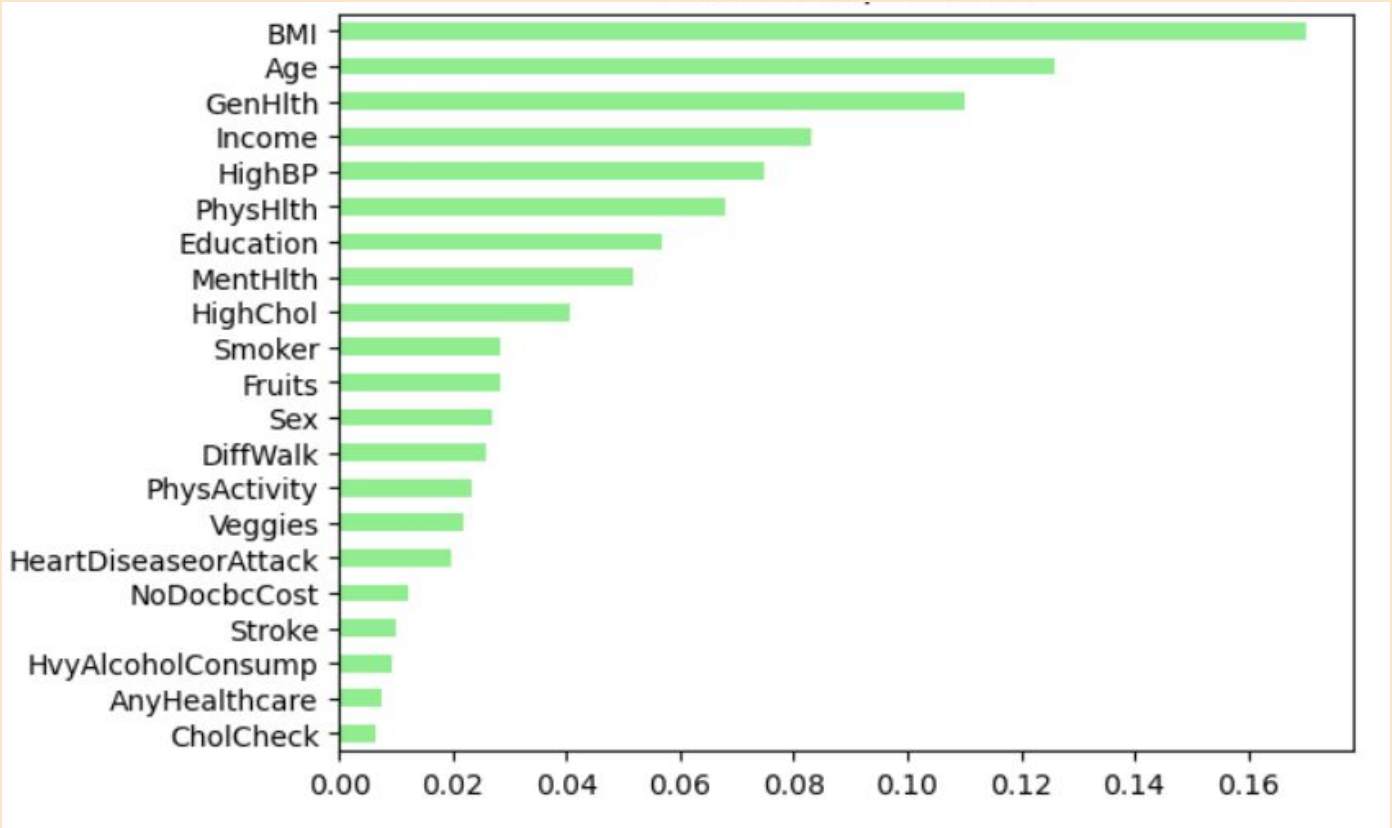


🧠 **Formula:**

$\hat{y} = \text{majority\_vote}(T_1(x), T_2(x), \ldots, T_□(x))$ Where:

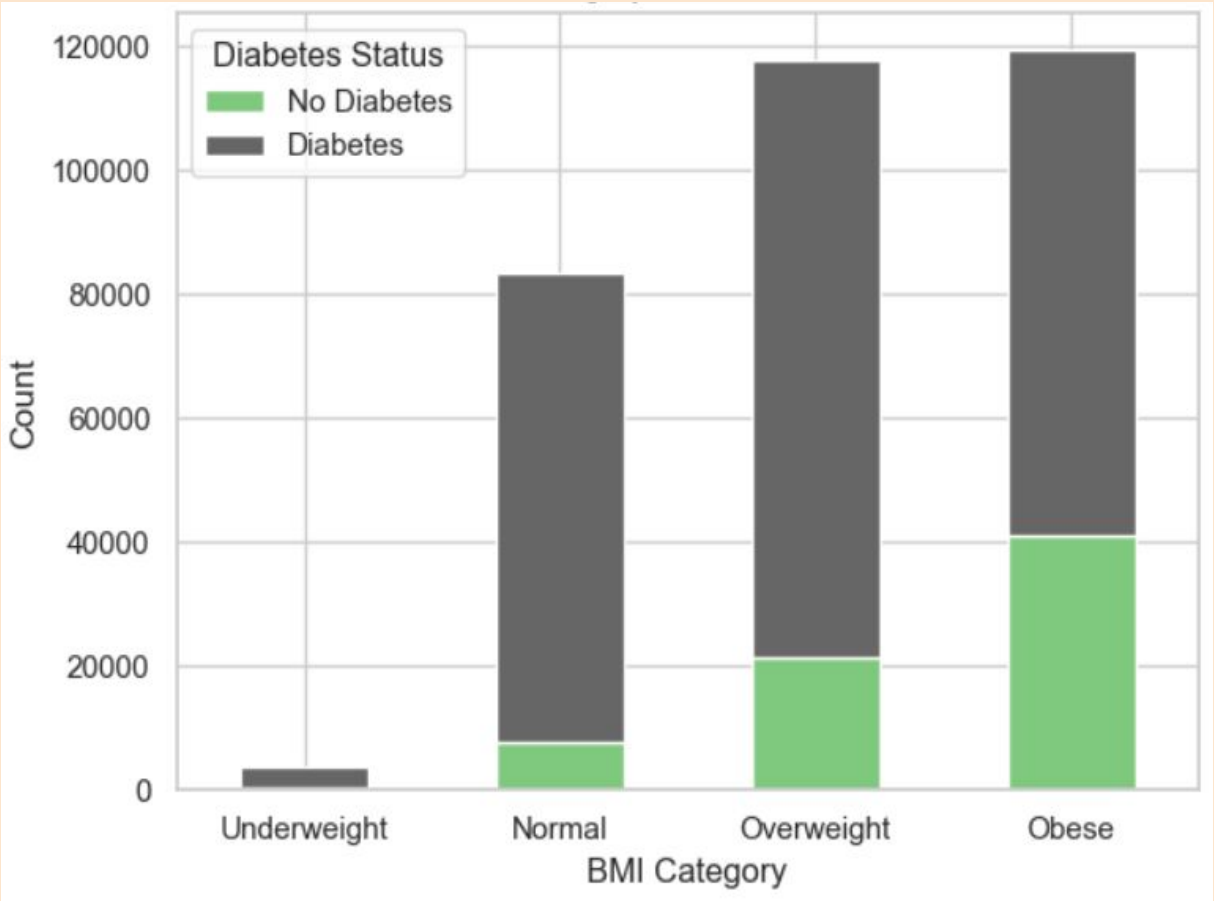
- $T(x)$ = prediction from each decision tree
- x = input features (BMI, Age, etc.)
- $\hat{y}$ = final prediction (0 = No Diabetes, 1 = Diabetic)

Feature Importance



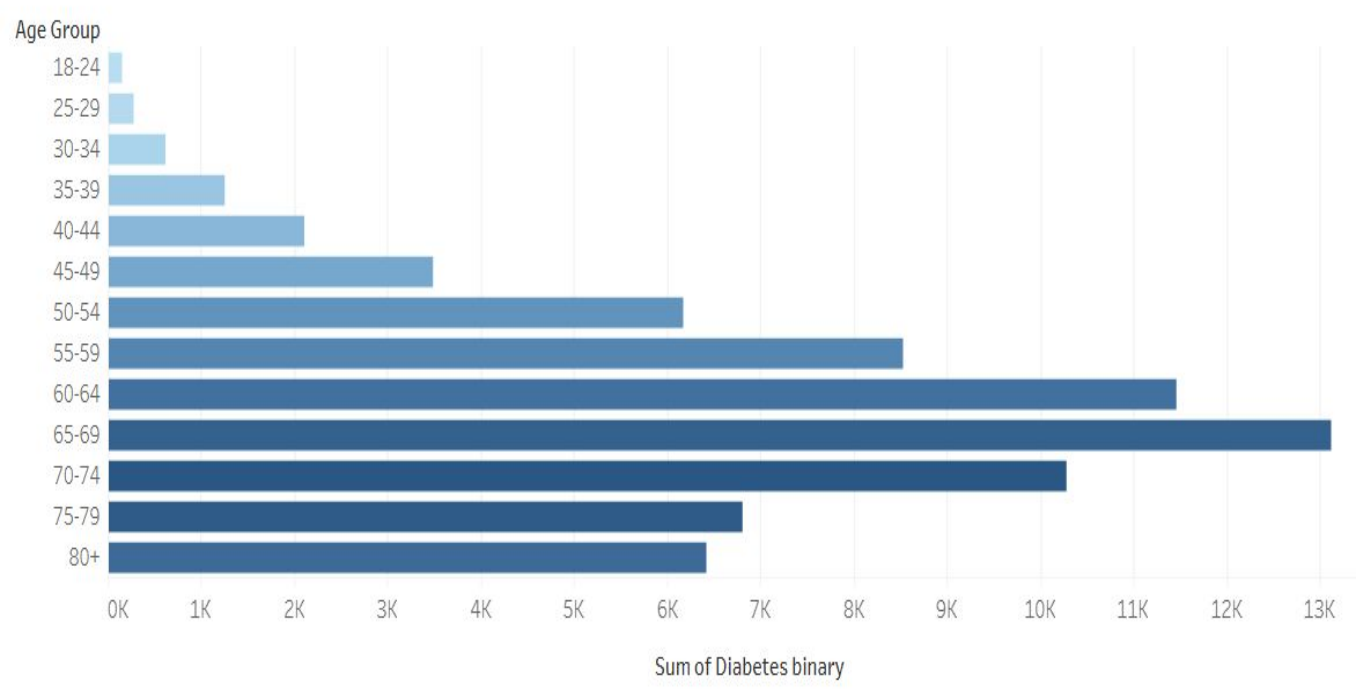
BMI vs Diabetes Status

- People with higher BMI have a higher risk of developing diabetes
- Higher BMI (especially obesity) often corresponds with insulin resistance, a major contributor to Type 2 diabetes.



Age vs Diabetes Prevalence

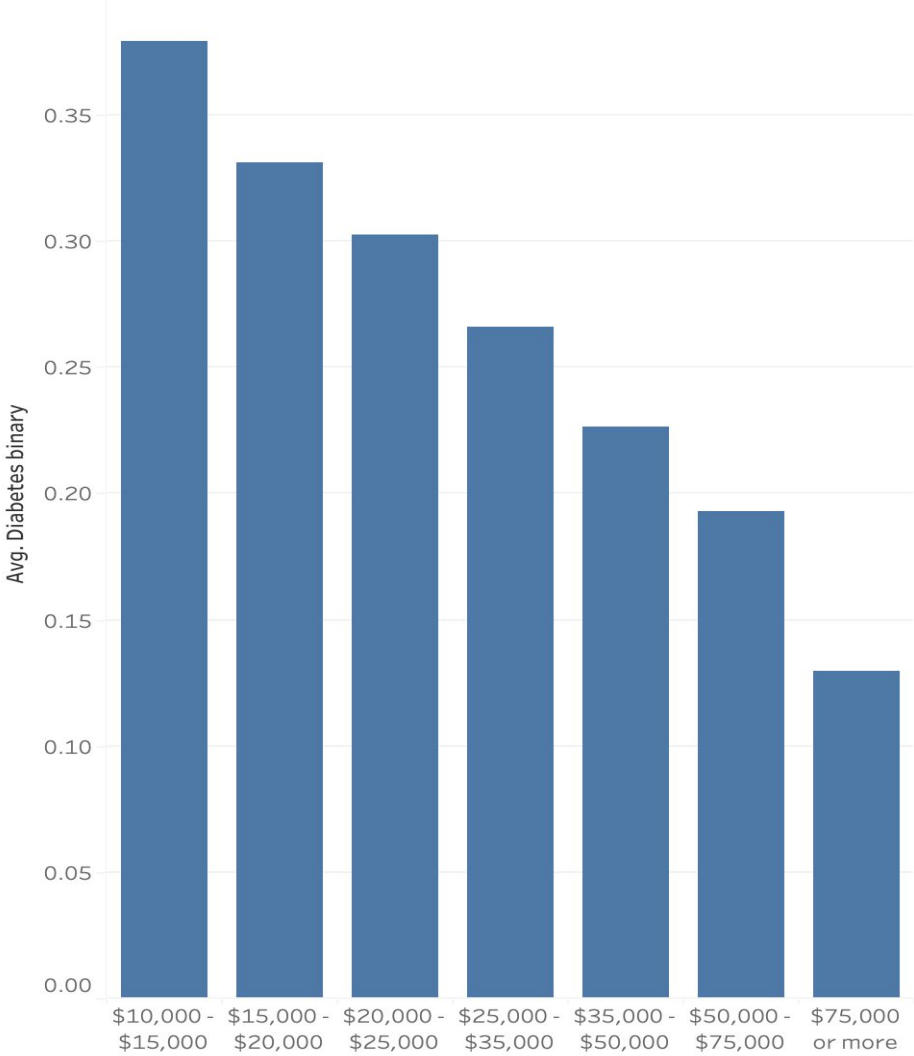
- Diabetes prevalence increases steadily with age.
- Individuals over 60 show significantly higher risk compared to younger groups.
- This trend holds for both sexes.



Objective 3

Income vs Diabetes Prevalence

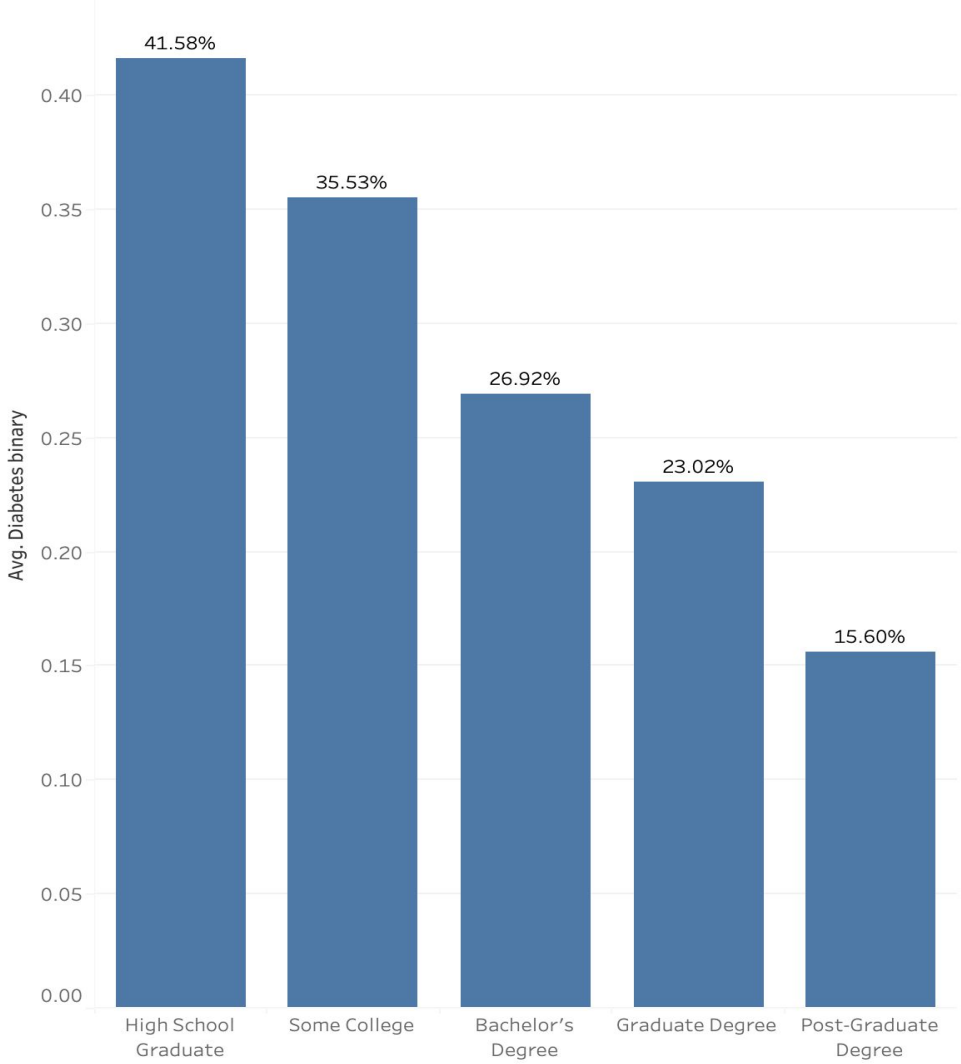
- Diabetes prevalence decreases as income increases.
- Individuals in lower-income brackets show higher risk, highlighting the need for targeted interventions.



Objective 3

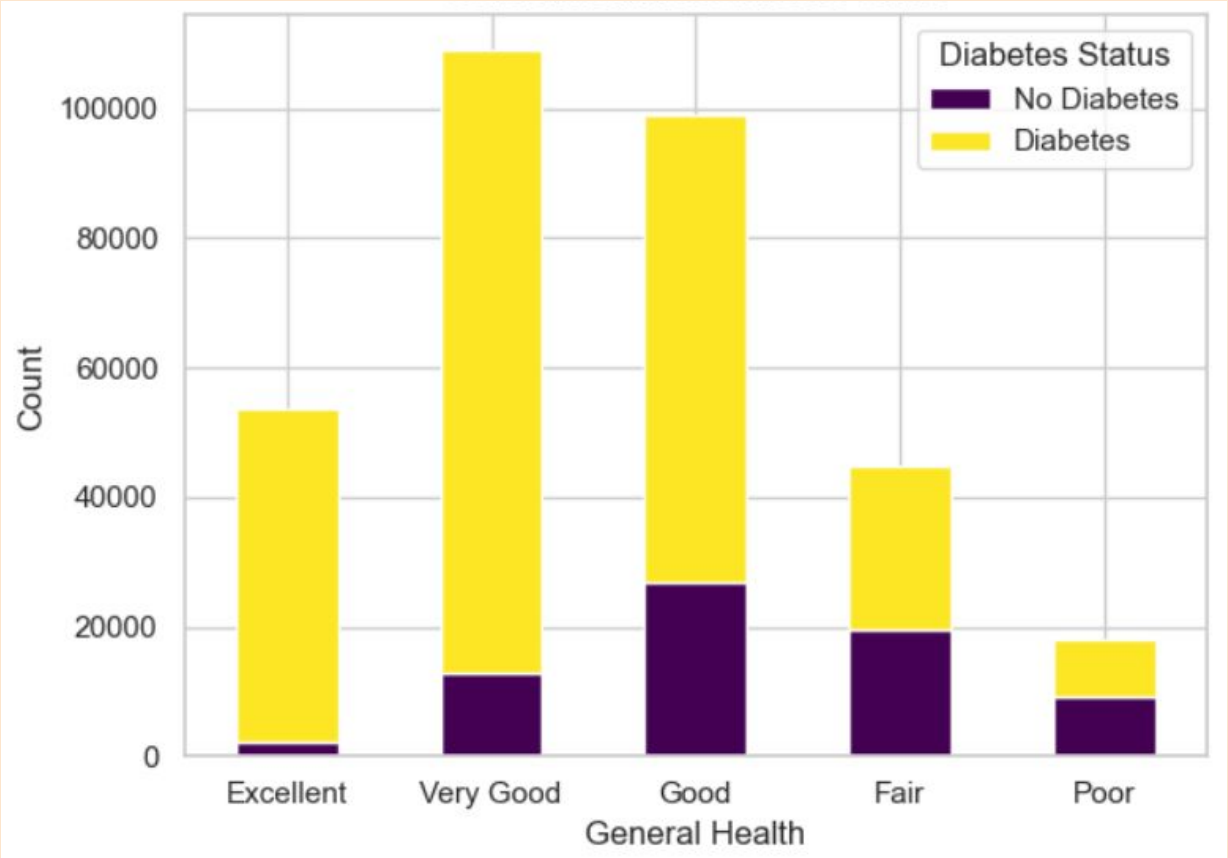
Education vs Diabetes Prevalence

- Higher level of education influence diabetes prevalence.



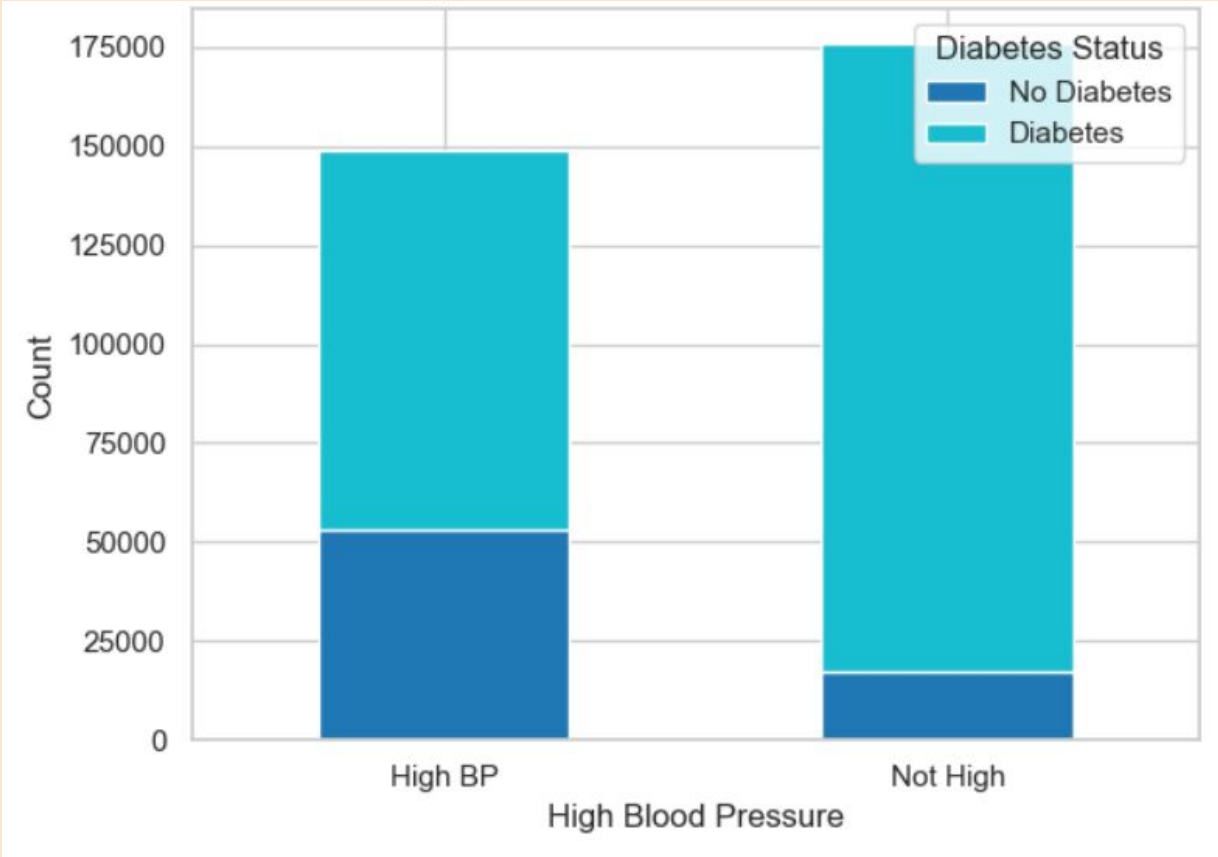
General Health vs Diabetes Status

- “Fair” and “Poor” categories have a higher proportion of people with diabetes
- The absolute count of people with diabetes is high in the “Good” and “Very Good” categories due to the larger population size in those categories



High blood pressure vs Diabetes Status

- Diabetes is more common among those with high blood pressure
- This happens because High blood pressure and diabetes share same risk factors: obesity, inactivity, poor diet, age, genetics.



Diabetes Predictor Model Deployment

- Using cleaned dataset model is trained using **Random Forest Classifier** using cross-validation
- Random Forest model is optimized with with basic hyperparameter tuning using **GridSearchCV**
- Features are scaled using **StandardScaler** for better performance
- Model has **91% accuracy** in predicting diabetes
- A **Gradio app** is used for users to enter their health parameters and calculates their Diabetes **risk level** (Low or High)

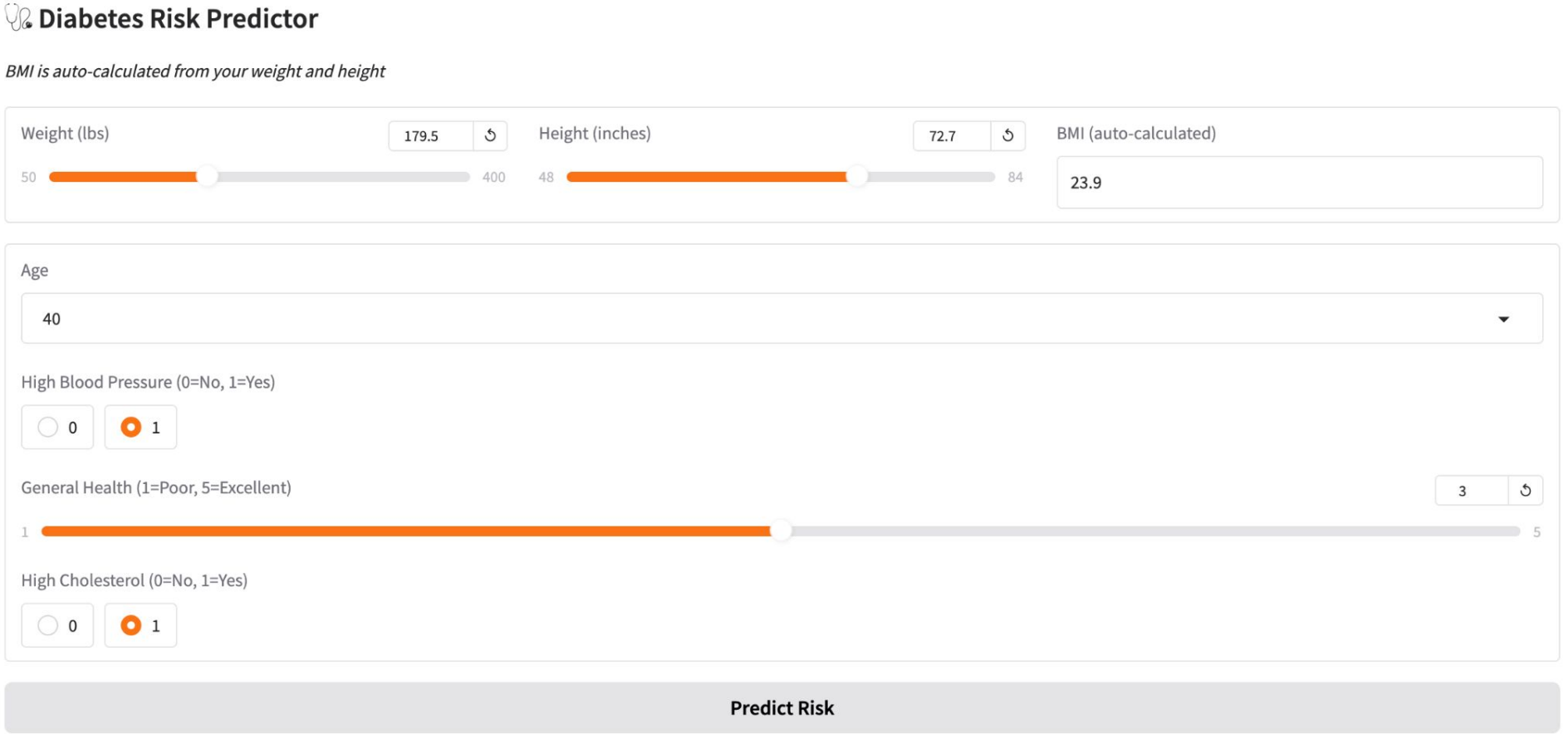
Confusion Matrix

	Predicted: No Diabetes (0)	Predicted: Diabetes (1)
Actual: No Diabetes (0)	True Negatives: 72,326	False Positives: 3,611
Actual: Diabetes (1)	False Negatives: 5,133	True Positives: 16,242

Classification Report

Classification Report:

	precision	recall	f1-score	support
0.0	0.93	0.95	0.94	75937
1.0	0.82	0.76	0.79	21375
accuracy			0.91	97312
macro avg	0.88	0.86	0.87	97312
weighted avg	0.91	0.91	0.91	97312



Access Live Demo

Conclusion and Limitations

- The model effectively identifies key health indicators contributing to diabetes risk, enabling personalized risk assessment.
- The interactive app allows users to input their lifestyle information and receive immediate, actionable diabetes risk scores.
- This approach supports early detection and promotes proactive health management.
- The model does not consider genetic or family history factors, which are important contributors to diabetes risk.
- Data used for training may not fully represent all demographic groups, which could affect model generalizability.

References

Dataset:

- Behavioral Risk Factor Surveillance System (BRFSS). Centers for Disease Control and Prevention (CDC). (2015). Diabetes Health Indicators Dataset. Retrieved from Kaggle: https://jmlr.csail.mit.edu/papers/v12/pedregosa11a.html

Tools:

- **Scikit-learn (sklearn):** https://scikit-learn.org/stable/. *Documentation for models, metrics, and preprocessing*.
- **Pandas:** https://pandas.pydata.org/. Data manipulation and analysis.
- **NumPy:** https://numpy.org/. Numerical computing in Python.
- ChatGPT

Tableau live link:
https://public.tableau.com/app/profile/shahab.eshghifard/viz/Book1_17491728312230/ExploringDiabetesRiskFactors

THANK YOU